

Application No. 10/564,015
Paper Dated: September 15, 2008
In Reply to USPTO Correspondence of April 25, 2008
Attorney Docket No. 0149-053929

CLAIMS

This listing of claims will replace all prior versions and listings of claims in the application. No amendments are being made to the claims; however, the status of claims 9-18 has changed due to the Restriction Requirement issued in the Office Action.

Listing of Claims

Claim 1 (Previously Presented): A process for forming a metal oxide film comprising a vapor deposition step in which a vapor of a hydrolysable metal compound and water vapor are brought into contact with a substrate to form a film of a metal oxide precursor on the surface of the substrate and a calcinations step in which the substrate is then heated in an oxidizing atmosphere to convert the precursor into a metal oxide, wherein in the vapor deposition step, the hydrolysable metal compound vapor and the water vapor are previously mixed and the mixed vapors are brought into contact with the substrate within 3 seconds after mixing.

Claim 2 (Original): The process according to claim 1 wherein the vapor deposition step is carried out by injection of jetted streams of the hydrolysable metal compound vapor and water vapor toward the substrate which is continuously moving, and the mixing is performed by injecting the hydrolysable metal compound vapor and the water vapor in such a manner that the resulting two jetted vapor streams meet each other before they reach the substrate.

Claim 3 (Original): The process according to claim 2 wherein the hydrolysable metal compound vapor is injected in a reverse direction with respect to the direction of movement of the substrate through a multi-orifice nozzle, and the water vapor is injected through a slit nozzle.

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Claim 4 (Original): The process according to claim 2 wherein the angles of the center lines of the streams of the hydrolysable metal compound vapor and water vapor (θ_M and θ_{H_2O} , respectively) satisfy the following relationship:

$$30^\circ \leq \theta_M \leq 80^\circ \text{ and } \theta_M \geq \theta_{H_2O},$$

and the flow rate of the stream of the hydrolysable metal compound vapor is greater than that of the water vapor.

Claim 5 (Previously Presented): The process according to claim 1 wherein the hydrolysable metal compound is a metal chloride.

Claim 6 (Original): The process according to claim 5 wherein the metal chloride at least predominantly comprises $TiCl_4$, the temperature of the substrate in the vapor deposition step is in the range of 150 – 250 °C, and the heating temperature in the calcination step is in the range of 300 – 600 °C.

Claim 7 (Previously Presented): The process according to claim 6 wherein the proportions of the $TiCl_4$ vapor and the water vapor fed to the vapor deposition step are such that they give a $TiCl_4/H_2O$ molar ratio in the range of 0.05 – 4.

Claim 8 (Original): The process according to claim 1 wherein the metal oxide film functions as a photocatalyst.

Claim 9 (Withdrawn): A vapor deposition apparatus for forming a film on the surface of a continuously moving substrate by a reaction between two vapors, wherein the apparatus comprises a multi-orifice nozzle and a slit nozzle disposed in such directions that the vapor streams injected through the respective nozzles meet each other.

Claim 10 (Withdrawn): The vapor deposition apparatus according to claim 9 wherein the multi-orifice nozzle is disposed such that a vapor is injected therethrough in a reverse direction with respect to the direction of movement of the substrate.

Claim 11 (Withdrawn): The vapor deposition apparatus according to claim 9 wherein the pitch between adjacent orifices of the multi-orifice nozzle is in the range of from 3 mm to 10 mm.

Claim 12 (Withdrawn): The vapor deposition apparatus according to claim 9 wherein the two vapors are a vapor of a hydrolysable metal compound and water vapor, and the hydrolysable metal compound vapor is injected through the multi-orifice nozzle and the water vapor is injected through the slit nozzle.

Claim 13 (Withdrawn): The vapor deposition apparatus according to claim 12 wherein the angle θ_1 between the center axis of the multi-orifice nozzle and the surface of the substrate is in the range of from 30° to 80°, and the angle θ_2 between the center axis of the slit nozzle and the surface of the substrate is smaller than θ_1 .

Claim 14 (Withdrawn): The vapor deposition apparatus according to claim 13 wherein angle θ_1 is in the range of from 45° to 75°, and angle θ_2 is in the range of from 10° to 40°.

Claim 15 (Withdrawn): The vapor deposition apparatus according to claim 12 wherein the hydrolysable metal compound is a metal chloride.

Claim 16 (Withdrawn): The vapor deposition apparatus according to claim 15 wherein the metal chloride at least predominantly comprises TiCl4.

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Claim 17 (Withdrawn): The vapor deposition apparatus according to claim 10 wherein the pitch between adjacent orifices of the multi-orifice nozzle is in the range of from 3 mm to 10 mm.

Claim 18 (Withdrawn): The vapor deposition apparatus according to claim 10 wherein the two vapors are a vapor of a hydrolysable metal compound and water vapor, and the hydrolysable metal compound vapor is injected through the multi-orifice nozzle and the water vapor is injected through the slit nozzle.